AN ARTICLE OF APPAREL

This invention relates to an article of apparel having a portion that can be illuminated, particularly but not exclusively, an item of footwear such as a shoe.

It is known to provide articles of apparel, such as shoes, with portions that can be illuminated for decorative or safety purposes, for example to enable the wearer to be seen at night. In such shoes, the portion may be illuminated by lights such as light emitting diodes (LEDs). Such LEDs may be arranged within the heel portion of shoe and be arranged to be permanently illuminated, or to flash intermittently (e.g. with the footsteps of the wearer of the shoe).

An aspect of the present invention provides an article of apparel carrying a chamber having a light transmissive wall portion and means for illuminating the chamber, the chamber having light affecting means, such that, in use, light from the illuminating means is scattered or reflected by the light affecting means.

The light affecting means may be light affecting particles freely moveable in the chamber. As another possibility, the light affecting means may be mounted to a part of the chamber but able to move (for example to twist, rotate, oscillate or vibrate relative to the chamber) in response to motion of the wearer. In this case, the motion of the light affecting means is constrained by the mounting. As another possibility or additionally a wall portion of said chamber opposed to the light transmissive wall portion (a "back" wall) may have one or more light affecting regions (e.g. regions that ar made up of light reflecting material). The one

or more light affecting regions on the "back" wall of said chamber may be pictures or dots.

The "back" wall of said chamber may be dark in colour, e.g. black, to provide a good contrast with the light affecting means.

In an embodiment, the illuminating means may be provided on movement means to enable relative movement between the illuminating means said light affecting means.

The chamber may contain a liquid such as water or an oil. Where water is used it may be distilled water. As another possibility, the chamber may contain a gel.

Where the liquid is a liquid such as water and the light affecting means are particles that are freely movable in the chamber, a surfactant may be added to a liquid in the chamber to reduce the surface tension of the liquid to facilitate prevention of light affecting particles floating on the surface of the liquid, where the light affecting particles are of lower density than the liquid, for example where the light affecting particles are glitter and the liquid comprises water. Further, an additive such as ascorbic acid may be added to keep the liquid clean and free from bacteria.

The light transmissive wall portion, or window, of said chamber may be formed of light transmissive plastics material.

The illuminating means may comprise one or more Light Emitting Diodes (LEDs) that may be of the same or different colours. The illuminating means may be arranged to be hidden from view.

In an embodiment the light affecting means may be light scattering or reflecting particles moveable within the chamber such as light reflecting and/or coloured, such as metallic, coloured glass or coloured plastic particles.

A control means may be provided for activating the illuminating means. The control means may be responsive to motion of the user, for example to footsteps of the user.

The control means may include a motion sensor such as a piezoelectric, mechanical, tilt, or pressure switch.

In an embodiment with more than one illuminating means, the control means may be arranged to activate said more than one illuminating means in a predetermined sequence.

The article of apparel may be a shoe and the chamber provided on the side or in the toe or heel of said shoe.

Another aspect of the present invention provides an article of apparel such as a shoe comprising a light source and directing means for directing light from the light source to a surface in the vicinity of the article of apparel, wherein for directing means is moveable relative to the article of apparel so that light from the light source moves about a surface relative to the article of apparel, providing an attractive and interesting moving light pattern on the surface near the article of apparel, thereby increasing the appeal of the shoe.

The directing means may be light affecting means such as reflective elements.

The surface may be the ground or a floor but could, for example, be a wall or a ceiling.

In some embodiments the region of the ground illuminated by the light is positioned with respect to the shoe so that the wearer of the shoe can readily see the light, thereby allowing the wearer (as well as other people) to enjoy the moving pattern of light around the shoe.

Embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a perspective diagram showing a shoe embodying the invention;

Figure 2 is a schematic block diagram of a circuit for controlling illumination means shown in Figure 1;

Figure 3 is an exploded perspective diagram showing another shoe embodying the invention;

Figure 4 is a flow diagram showing a sequence of events which occur in the circuit of Figure 2;

Figure 5 is a perspective diagram showing a rear perspective view of another shoe embodying the invention;

Figure 6 shows a perspective view of another shoe embodying the invention being worn by a wearer;

Figure 7 shows a side view of the shoe shown in Figure 6, partly cut-away to show an electrical system and a hydraulic system incorporated within a sole of the shoe;

Figure 8 shows a part-sectional, part cut-away view of part of the shoe shown in Figures 6 and 7;

Figure 9 shows a schematic diagram illustrating one example of a hydraulic system that may be incorporated within the sole of the shoe shown in Figures 6 to 8;

Figure 10 shows a part-sectional, part cut-away view similar to Figure 8 to illustrate a modification of the shoe shown in Figures 6 to 8; and

Figure 11 shows a part-sectional, part cut-away view similar to Figure 8 to illustrate another modification of the shoe shown in Figures 6 to 8.

Figure 1 illustrates a shoe 1 having an upper 3 and a sole 5. An aperture is provided in said upper 3 having a pocket behind (not shown) to receive a chamber 9. The chamber 9 contains light affecting particles. In this embodiment, said chamber contains a liquid consisting of 75% distilled water and 25% surfactant (fluoro chemical surfactant FC-170C, produced by Fluorad™) and containing as the light-affecting particles metallic particles 900 in the form of so-called glitter that is commercially available at many outlets such as newsagents, stationers and the like.

The chamber is a plastics material chamber into which the liquid is injected through an aperture which is then sealed.

The surfactant is provided to reduce the surface tension of the water, to inhibit the glitter from merely floating on the surface of the water. An additive such as ascorbic acid may also be added to the water/surfactant

mixture to keep it clean and also to prevent the formation of bacteria.

The shoe 1 is also provided with an illuminating arrangement 11 which consists of two sets of LEDs contained in respective pouches 15 secured, for example by stitching or gluing, to the inside of the upper 3 of said shoe 1 on either side of the chamber 9. In this particular embodiment, there are three LEDs arranged on each side of the chamber with a red LED, a green LED and a blue LED on each side. A light-transmissive wall portion or window 9a of said chamber 9 allows the affect of the particles on the light to be viewed. Positioning the LEDs on either side of the chamber 9 means that they cannot be viewed through the wall portion or window 9a. A "back" wall of said chamber (that is a wall opposed to the light transmissive wall portion 9a) is dark in colour, e.g. black, to enable the effect of the particles on the light to be viewed more easily through the wall portion or window 9a.

A control circuit 13 is provided in the sole 5 of said shoe 1 for controlling activation of the LEDs 11.

Figure 2 shows a functional block diagram of the control circuit and its coupling to the LEDs.

As shown in Figure 2, the control circuit 13 comprises a piezoelectric switch 17, a microcontroller (or microprocessor with associated memory) 19 and a number of LED drivers 21 for driving LEDs 11. The piezoelectric switch 17 is coupled to the microcontroller 19 and is arranged to detect changes in pressure in the material of the sole 5 of the shoe 1 in which it is embedded, i.e. changes in pressure in the sole 5 due to the wearer's

footsteps. The microcontroller 19 is arranged to output control signals for causing activation of LEDs 11 when the output from the piezoelectric switch 17 rises above a threshold voltage V_t.

The LED drivers 21 are of conventional form and may be integrated circuit (IC), or made up of discrete components. Further, the entire control circuit 13 may be provided as a single integrated circuit.

It will, of course, be appreciated that, in the interests of simplicity, the power supply connections to the components of the control circuit 13 are not shown in Figure 2. The power source for such a circuit may be a battery (not shown) located in the sole of the shoe. The battery may be secreted in the heel of the shoe or it may be mounted within a compartment accessible by the wearer so that the wearer may change the battery 701 when it is discharged.

Figure 3 shows an exploded perspective diagram of another shoe embodying the invention.

Like reference numerals are used to indicate those parts which have previously been described in Figure 1.

The shoe in Figure 3 differs from that described above in that the chamber 9 is provided in a self-contained illumination unit 150 (formed of cloth or moulded from rubber or a plastics material, for example) which is arranged such that it can be attached to a portion 15, (shown in phantom lines) of the shoe 1 by, stitching or adhesive, or the like. The LEDs 11 are arranged on either side of the chamber 9 within said illumination unit 150. A flap 150a extending from a main body of the

illumination unit 150 contains wires for coupling the LEDs 11 to the control unit 13. As shown in the figure, when the illumination unit 150 is in position on area 151 on the upper 3 of the shoe 1 the portion 150b of the illumination unit 150 from which the flap 150a extends is aligned with the region where the upper 3 meets the sole 5 of the shoe 1. The flap 150a is received within the sole 5 such that it cannot be seen when the sole 5 is attached to the upper 3. The ends of the wires from the LEDs 11 emerging from the end of the flap 150a remote from the illumination unit 150 are coupled to the control unit 13.

The operation of the microcontroller 19 and how it causes the chamber 9 to be illuminated as the wearer of the shoe 1 moves will now be described with reference to Figure 4.

As shown in Figure 4, at step S1 the microcontroller 19 monitors the output from the piezoelectric switch 17 to detect whether the output is above the voltage threshold V_t (Step S1). If the output voltage is above the threshold level V_t the microcontroller outputs control signals to the LED drivers 21 (step S2) to cause the LEDs to light up in a lighting sequence. If the output of the piezoelectric switch 17 is below the threshold voltage V_t the microcontroller 19 repeats step S1. As the lighting sequence is being output to said LED drivers the microcontroller continues to detect the output of the piezoelectric switch 17 (step S3) and outputs the control signals to the LED drivers 21 (step S2) until, at step S3, the microcontroller 19 determines that the output of the piezoelectric switch 17 has fallen below the threshold voltage V_t. The microprocessor 19 then stops

outputting the control signals to the LED drivers 21 (step S4) and returns to step S1.

The control signals may cause the LEDs to light in any predetermined sequence. In the present embodiment, the control signals cause the red, green and blue LEDs 11 arranged on one side of the chamber to flash alternately with those arranged on the other side of said chamber. In other examples the control signals may cause all the LEDs 11 to flash on and off with each footstep of the wearer of the shoe 1, or cause half of the LEDs 11 to flash during one footstep, and the other half of the LEDs 11 to flash during the other footstep. The microcontroller 19 may also be programmed with a number of different lighting sequences and be programmed to move from one lighting sequence to another in a predetermined order or at random. In addition, the or a lighting sequence may be a random lighting sequence.

Figure 5 shows a rear portion of another shoe embodying the invention.

Like reference numerals are used to indicate those parts which have previously been described in relation to Figure 1.

The shoe shown in Figure 5 differs from that shown in Figure 1 in that the chamber 9 is provided in a heel portion 1a of said shoe 1 and in the placement of the LEDs 11. Thus, as shown, the LEDs 11 are arranged within the heel of the shoe 1 so that light emitted from the LEDs 11 shines outwards through the chamber 9. The LEDs, however, are still arranged so that they cannot be seen through the window or wall portion 9a.

An advantage of providing the chamber 9 in the heel portion of the sole 5 of the shoe 1 as shown in Figure 5 is that the chamber 9 can be easily accommodated in the moulding process.

The control circuit required to drive the LEDs 11 is identical to that previously described in relation to Figures 2 and 4.

Another shoe 601 embodying the present invention will now be described with reference to Figures 6 to 9 in which Figure 6 shows a perspective view of the shoe being worn by a wearer, Figure 7 shows a side view of the shoe, partly cut-away to show an electrical system and a hydraulic system incorporated within a sole of the shoe, Figure 8 shows a part-sectional, part cut-away view of part of the shoe and Figure 9 shows a schematic diagram illustrating one example of a hydraulic system that may be incorporated within the sole of the shoe.

As shown in Figures 6 and 7, the shoe 601 (which may be a training shoe or a trainer, for example) has an upper 602 and a sole 603. The upper 602 includes an aperture 602a for introducing a foot into the shoe 601 and laces 602b for securing the shoe 601 to the foot of the wearer 600 (Figure 6).

As shown in Figure 8, a hollow chamber 605 is captured (by gluing, stitching or the like) between inner and outer skins 602i and 602o of a side surface of the upper 602 which is outermost when the shoe is being worn so that a front wall surface 605a of the chamber 605 projects through a generally circular aperture 602' in the outer skin 602o. The chamber 605 is moulded from a light-transmissive, for example cl ar, plastics m terial

and is filled with water which may contain additives as described above.

Generally, the chamber 605 is mounted on the left hand side surface of a left hand shoe and on the right hand side surface of a right hand shoe, but it may be mounted at the rear or front of the shoe. Also, two or more chambers may be provided.

A disc 606 is provided within the chamber 605. The disc 605 has a spindle 802 which extends centrally, in this case, from a rear surface of the disc and is rotatably mounted (by means of bearings, not shown) on an axle 801 secured to the inner skin of the upper by means of, for example, a rivet connection or the like. The disc 606 can thus rotate about its axis. The disc is, in this example, shaped so that its outer surface is outwardly convex as shown in Figure 8 to enable the disc to fit within the chamber.

The front surface of the disc carries light affecting means in the form of reflective facets 613 which may be formed of reflective foil elements secured to the disc or may be shaped from metal sheet, for example.

The reflective facets 613 are oriented to reflect light from light sources 607 provided within the shoe down onto the ground or floor adjacent the wearer. In this example as shown in Figure 8, the light sources 607 are mounted between a lower portion of the chamber 605 and the outer skin of the upper 602 so as to direct light into the chamber 605 towards the facets 613 and are provided as three Light Emitting Diodes (LEDs) 607: a red LED 607r, a green LED 607g and a blue LED 607b.

The relative positions and orientations of the facets 613 and the LEDs 607 are such that light emitted by the LEDs 607 is reflected by the facets 613 onto a region 614 (shown in dashed lines in Figure 6) of the floor or ground adjacent the wearer to produce illuminated regions 609r, 609g and 609b, respectively. The path taken by the light is illustrated by the rays 608r, 608g, 608b, respectively.

The light sources 607 are controlled by a controller 604 which is, in this example, mounted within a heel portion of the sole and is coupled to the LEDS 607 via wires 604a sandwiched between the inner and outer skins of the upper 602. The controller 604 may have the form described above with reference to Figure 2 except that the piezoelectric switch 17 will be omitted and the operation of the LEDs controlled entirely by the microcontroller 19.

The heel portion also incorporates a hydraulic system that, in accordance with movement of the wearer's heel as will be described below, pumps water onto impeller blades 803 carried by the spindle 802. In this example, as shown in Figure 8, the hydraulic system includes a bellows-like resilient water-filled sac 610 positioned beneath a depressable portion 620a of an inner sole 620 of the shoe so that the application and removal of pressure from the user's heel causes the water sac 610 to compress and then to re-expand to pump water around the hydraulic system. The water sac may be formed from a plastics material.

As is discussed later in more detail, pumping of water by the water sac 610 causes rotation of the disc 606 so that th reflection of light by the facets and thus th

positions of the illuminated regions 609 vary. Thus, as the disc 606 rotates, the illuminated regions 609 will move around, for example dance or gambol, within the projection area 614, thereby providing an interesting and attractive visual effect.

Figure 9 shows a schematic diagram illustrating one example of the hydraulic system 800 that may be incorporated in the shoe 601.

In this example, the water sac 610 is coupled to the chamber 605 by two tubes 611 and 612. A first non-return valve 806 allows water to exit the water sac 610 and to flow along the tube 611 to a nozzle 804 opening into the chamber 605 and orientated so as to direct water onto the impeller blades 803 when the water sac 610 is compressed by the heel of the wearer of the shoe 601 while a second non-return valve 805 allows water flowing from an outlet orifice 805 of the chamber 605 along the tube 612 to enter the water sac 610 when the water sac 610 returns to its normal uncompressed state when the wearer lifts or removes the heel pressure.

Accordingly, the wearer can cause the hydraulic system to pump water into the chamber to rotate the disc 606 and so cause the pattern of light reflected onto the floor or ground to change by lifting and lowering their heel, for example by walking, running or dancing.

The rotational inertia of the disc 606, the viscous drag between the disc and water inside the chamber 605 and friction between the disc and the axle 801 may be arranged so that, once spinning, the disc takes a short while, for example a few seconds, to come to rest.

Figure 10 shows a part-sectional, part cut-away view similar to Figure 8 to illustrate a modification of the shoe shown in Figures 6 to 8. This shoe differs from the shoe shown in Figures 6 to 8 in that the hydraulic system is omitted and the disc 605 is replaced by a plurality (only one is visible in Figure 10) of mirrors or reflective elements 901g. Each mirror 901g is attached to a spring or resilient arm 902g which in turn is attached to the chamber 605 at an attachment point 903g. Each spring 902g is formed from a strip of plastics material and allows the attached mirror 901g to move within the chamber, for example to bounce or twist with respect to the shoe 601 when the wearer moves around, for example walks, runs or dances.

The mirrors 901 reflect light from the LEDs 607 onto the projection area 614, with the light being refracted through an angle α on entry into the air, and the pattern of light again changes as the mirrors move with movement of the wearer.

In this example, three LEDs 607 and three mirrors 901 are provided, although only the green LED 607g and its associated mirror 901g are visible in Figure 10. The path of the light reflected from the mirror 901g onto the ground 614 to form a green dot 609g is shown diagrammatically by the ray 908g.

The masses of the mirrors 901g and the stiffness of the springs 902g are selected so that, in conjunction with the damping effect due to the viscosity of the water 904, the mirrors 901g oscillate at a suitable frequency (for example 3Hz) and with a suitable decay time constant (for example 1s) when the mirror 901g is perturbed due to an acceleration of the sho 601.

Figure 11 shows a part-sectional, part cut-away view similar to Figure 8 to illustrate another modification of the shoe shown in Figures 6 to 8. This shoe differs from the shoe shown in Figure 6 in that the hydraulic system is omitted, the chamber 605 is filled with air or another, inert, gas rather than water and the disc 606 is replaced by reflector assemblies 1001 to reflect the light from the LEDs 607. In this example three LEDs 607 and three reflector assemblies 1001 are provided, although only the green LED 607g and its associated reflector assembly 1001g are visible in Figure 11.

Each reflector assembly 1001 comprises an elastic filament 1002 stretched across the chamber 605 and secured to the chamber wall at its ends to form a chord. Reflectors are mounted on the filaments. For example, as can be seen in Figure 11, three reflectors 1003ga, 1003gb, 1003gc (each of which is angled to reflect light towards the ground or floor adjacent the shoe) are mounted on the filament 1001g. Depending upon the actual configuration of LEDS and reflectors, three separate illuminated regions 1008ga, 1008gb, 1008gc, may be formed by light (indicated by the dashed arrow lines in Figure 11) from the LED 607g reflected off the reflectors 1003g. Similar illuminated regions will be provided by the other reflectors and LEDs.

When the wearer of the shoe moves their foot, for example walks runs or dances, the filaments move or twist so that reflectors 1003g move or twist about their respective filaments 1002g, and with respect to each other. The reflectors may also change their attitude with respect to the filament 1002g, and with respect to each other. The light pattern projected on the floor will thus change with movement of the wearer. As mentioned above, the

illuminated regions may appear to be independent, advantageously providing an increase in the number of illuminated regions visible to the wearer.

In the embodiments described with reference to Figures 1 to 5, the chamber 9 may be filled with a liquid other than the water and surfactant mixture and having a different viscosity, thus altering how the particles move with said liquid. An example of liquid that may be contained within the chamber 9 is a light oil. Further the ratio of water to surfactant may differ from that in the embodiments. As another possibility, the chamber may contain a gel or gas within which the particles are suspended. The liquid or gel may be colourless or coloured. The chamber 9 may also contain two immiscible liquids (e.g. oil and water) which may be of different colours and each one of said two immiscible liquids may have the same or different colour particles suspended therein. Also, even where the liquid comprises water the use of a surfactant may not be necessary if the particles are such as to be neutrally buoyant in the liquid.

In the embodiments described with reference to Figure 6 to 10, the chamber contains water and the refraction of the light as it exits the chamber and passes into the lower refractive index air enables the light pattern to be projected to a projection area closer to the shoe 601, thereby achieving a higher intensity light pattern than would be the case if the chamber contained air. Other liquids than water may be used, for example those mentioned above.

It may also be possible in the embodiments shown in Figures 6 to 10 to fill the chamber with a gas such as air rather than water. For example, the hydraulic system

800 shown in Figures 6 to 9 may be replaced by a pneumatic system. Whereas the hydraulic system 800 was closed (i.e. water was pumped from the water sac 610 to the chamber 605 from where it returned via the tube 612 to the water sac 610), a pneumatic system may be open. In an open system the water sac 610 would be replaced by an air sac which would pump ambient air from the heel of the shoe 601 via the tube 611 onto the impeller blades 802. The chamber 605 would be provided with vent holes to allow the air from the tube 611 to return to the ambient atmosphere. The tube 612 would be superfluous although the air sac would still be provided with the valve 805 and preferably also the valve 806.

The use of water to rotate the disc 606 provides the advantage that, due to the relatively high density of water, it will be relatively easy to rotate the disc 606. However, if the water sac 610 is not continuously pumped then viscous damping of the disc 606 will bring the disc 606 to a halt relatively quickly. On the other hand, if air is used to rotate the disc 606 then, although it may be more difficult to rotate the disc 606 due to the lower density of air, the disc 606 will not be subject to the same degree of viscous damping and so may rotate for longer.

Where the chamber contains water or other liquid, the embodiments described above may be combined so that, for example, the chamber may contain light affecting particles as well as the disc or mirrors.

The shape of the chamber 9 may also be different from that shown in the Figures. As an example, the chamber 9 may take the form of the manufacturer's logo, and there may be more than one chamber provided on the sho which

may have different colour LEDs. As another example, the chamber may be replaced by a transparent cuboid.

In the embodiments shown in Figures 6 to 11 if the chamber does not contain liquid, it may be possible to dispense with the chamber 605, although its retention is preferred for safety reasons and the protection of, for example, the disc 606 or the reflector assemblies 1001.

In the embodiments using a motion sensor, the piezoelectric switch may be replaced by a mechanical switch such as a cantilevered spring or a pressure switch, to detect pressure changes in the sole of the shoe which correspond to a wearer's footsteps, or a mercury tilt switch to respond to changes in attitude of the shoe due to the footsteps of the wearer.

The back wall of the chamber 9 may be light reflective to enhance the effect of the light affecting means on said light emitted from said LEDs 11.

The back wall of said chamber may be provided with light affecting portions which may be light affecting, e.g. light reflecting, particles embedded in the back wall or may be provided as light affecting regions of a picture on the back wall formed using, for example a light reflective paint. This feature may be provided in place of or in addition to providing light affecting particles in the chamber.

The illuminating means may be provided on movement means (that is, for example, the couplings of the LEDs to the control unit may include spring elements) such that the illuminating means move as the wearer moves.

Further, said light affecting portions on said back wall may be a picture, or dots.

In another arrangement, the LEDs may be arranged such that they are visible through said chamber when viewing said chamber.

As described above, when provided, the light affecting particles are metallic particles such as glitter. These may be replaced by other types of reflective particles or by coloured glass or plastic particles or any combination of these. It may also be possible to use particles that fluoresce or phosphoresce when illuminated.

In a further embodiment (not shown), the disc 606 shown in Figures 6 to 9 may be provided with an eccentric weight so that movement of the shoe 601 causes the weight to swing about the axle 801, thereby causing the disc 606 to undergo damped rotatory oscillations about its axle 801. In this case, the hydraulic system may be omitted.

Hitherto, the embodiments described have used the motion of the shoe 601 or a pumped fluid to move the light affecting means. In the embodiment described above with reference to Figures 6 to 9, an electric motor may be used to slowly rotate the disc 606. The use of an electric motor offers the advantage that the disc 606 may be rotated even when the wearer of the shoe 601 is stationary, but has the potential disadvantage that the power drain on the battery will be increased. Similarly, the mirrors 901 shown in Figure 10 may be jostled by the use of miniature solenoids energised under the control of the microcontroller 703.

In the embodiment described above with reference to Figure 10, the reflective facets 613 of the disc 606 may be replaced by loops of a reflective ribbon-like material, for example strips of metallised plastic foil.

In the embodiments described above with reference to Figures 6 to 11, light from the LEDs 607 is reflected off a reflective surface (e.g. the reflective facets 613 or the mirrors 901). In other embodiments (not shown), light from the LEDs 607 may be shone through refractive elements, for example Fresnel lenses, instead of being reflected. If the example shown in Figure 10 were to be modified for use with refractive elements then the LEDs 607 would be positioned towards the top of the chamber 605 and the mirrors 901 would be replaced by Fresnel lenses so that the light from the LEDs 607 could shine through the lenses to form illuminated regions 609.

It may also be possible to use semiconductor lasers instead of the LEDs 607. Semiconductor lasers are potentially more efficient than LEDs, offering a greater battery life for the same intensity of illumination. Furthermore, the coherent nature of the light emitted from a laser allows the use of diffractive optical elements (DOEs) enabling the beam from the laser to be shaped into, for example, a circle, cross, line or into some other pattern. This beam shaping may be used to advantageously improve the appearance of the illuminated regions 609 within the projection area 614. Furthermore, as those skilled in the art will appreciate, although DOEs are dispersive they can in some circumstances be used with wider bandwidth light sources, for example LEDs, especially if combined with a compensating dispersive material.

The electrical system described above uses a microcontroller to control the illumination of the LEDs. In another embodiment, the LEDs may be connected directly to the battery so that they are illuminated continuously. Such an embodiment allows the microcontroller to be dispensed with but has the disadvantage that the life of the battery will be reduced due to the continuous illumination.

In the embodiments described above with reference to Figures 6 to 11, the projection area 614 is on the floor or ground but it could be on a wall or ceiling or other suitable surface.

In the embodiments described above with reference to Figures 6 to 11, recognisable images may be projected onto the projection area 614. Examples of recognisable images are trademarks, logos or user-defined images. User-defined images may be downloaded from a personal computer to the microcontroller 703 using a communications link, for example the electrical RS232 serial data interface or a Bluetooth™ wireless interface.

User defined images may be achieved either by allowing the wearer to select an image from a predetermined set of images or by downloading information specifying the appearance of an image, for example as pixel data. The ability to project user-defined images advantageously increases the appeal of such a shoe to the wearer of the shoe.

In embodiments where a recognisable image is projected, the reproduction of the image will generally be improved if the variation of intensity of illumination of the LEDs

607 is synchronised with, for example, movement of the disc 606 or mirrors 901. Such synchronisation may be achieved by using a sensor such as a shaft encoder to determine the position of the disc 606 so that the microcontroller 703 can energise the LEDs 607 appropriately. The sensor may, for example, be a slotted optoelectric position sensor or may use inductive position sensing techniques. Alternatively, if an electric motor or solenoid is used to rotate the disc 606 or agitate the mirrors 901 or reflectors 1003 then the energisation of the motor or solenoid may be synchronised with the energisation of the LEDs 607.

In the above described embodiments where the light affecting means is mounted so as to be movable with respect to the article or chamber, then the light effecting means may be mounted so as to be rotatable, vibratable, oscillatable, or movable along an eccentric path, for example.

In the above described embodiments, the light affecting means may be arranged to affect light by reflection, refraction and/or diffraction.

The light affecting means may alternatively or additionally be arranged to effect light by affecting polarisation.

In another embodiment, the chamber may contain a gas, such as argon or neon, for example, that generates light when an electrical discharge is passed therethrough. In this case, the components 11 shown in Figure 1 may be discharge electrodes and the element 13 shown in Figure 1 may comprise a piezoelectric element and control circuitry so that when a user takes a step, a

piezoelectric crystal is compressed generating a high voltage to cause an electrical discharge within the chamber so resulting in light emission. As another possibility, the light generating gas may be contained within the elements 11, that is the elements may themselves be discharged tubes such as neon discharge tubes so that, in this case, when the piezoelectric element is squeezed by foot pressure, light is generated by the light discharge elements. In this latter case, the element 13 may contain control circuitry for controlling the activation of the individual light discharge elements.

The features of the embodiments described above may be combined so that, for example, the light affecting elements described above with reference to Figure 1 are also contained within a chamber having the light affecting disk shown in Figures 6 to 9 or the light affecting elements shown in Figures 10 and 11.

The above described piezoelectric drive arrangement may also be used where the light emitting devices are LEDs rather than light discharge devices.

The chamber and control circuit, (or any hydraulic or pneumatic assembly), may be sold separately from a shoe so that a shoe manufacturer can fit the chamber and control unit to the shoe. Also, the illumination unit shown, for example, in Figure 3 may be sold separately for fitting to a shoe by a manufacturer.

As shown, the shoe is a sports shoe, for example a trainer. The present invention may, however, be applied to any type of footwear.

The present invention may also be applied with different articles of apparel e.g. gloves, t-shirts, shorts, etc. and the control unit activated by a motion sensor that detects motion of a wearer or of part of the wearer.